



Bond Math

Presented at the California Debt and Investment Advisory Commission's "Fundamentals of Debt Financing" Seminar

presented by

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Overview

- The Basics – Overview of Municipal Bonds
- Key Concepts – Basic Level
- Key Concepts – More Advanced Level
- Key Calculations From a Bond Sale
- The Use of Bond Insurance

Section 1

- The Basics – Overview of Municipal Bonds



← 105-120
WALL ST

What is a Bond?

- Bond: a promise or commitment
 - ❖ "A man's word is his bond"
- A form of loan
- A legal instrument which obligates a borrower (the local government or the "issuer") to repay a lender (the "bondholder")

Technical Aspects of Bonds

- Bear interest at a specified rate
 - ❖ Usually a rate which is fixed as long as the bond is outstanding
 - ❖ "fixed income" securities
- Bonds must be repaid at a specified date in the future
 - ❖ The "maturity date"

Sources of Funds for Repaying Bonds

- Pledged funds
 - ❖ Funds which the issuer has legally committed to use to repay the bond
- Types of bonds, based on sources of repayment

Tax Supported

General obligation

Limited obligation

Special taxes

Franchise taxes

Revenue Supported

Housing revenue

Water revenue

Electric revenue

Airport revenue

Quick History of Municipal Bonds in the U.S.

Local governments in the U.S. have been borrowing funds for several hundred years

- Mid-1800's
 - Municipal defaults following railroad expansion led to independent "validity" opinion
- Early 1900's
 - "Tax exemption" status followed adoption of Federal income tax
- 1950's & 1960's
 - Significant expansion in issuance of revenue bonds
- Early 1980's
 - Introduction of variable rate debt
 - Personal computers used on Wall Street
- 1990's
 - Introduction of swaps

Section 2

- Key Concepts – Basic Level



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WALL ST

Key Concepts – Basic Level

- Principal
- Maturity
- Interest
- Debt Service
- Coupon
- Price
- Yield
- Original Issue Discount
- Original Issue Premium
- Bond Proceeds
- Principal Amortization
- Serial Bonds
- Term Bonds
- Sinking Funds

Principal, Maturity, Interest, Debt Service

Year	Principal	Interest	Debt Service
2007		517,413	517,413
2008		517,413	517,413
2009	1,815,000	517,413	2,332,413
2010	1,895,000	435,738	2,330,738
2011	1,985,000	340,988	2,325,988
2012	2,095,000	236,775	2,331,775
2013	2,210,000	121,550	2,331,550
	10,000,000	2,687,288	12,687,288

Coupon, Price, Yield, Original Issue Discount, Original Issue Premium

Year	Principal	Coupon	Yield	Price	
2007	-				
2008	-				
2009	1,815,000	4.50%	4.75%	99.309%	Discount Bond
2010	1,895,000	5.00%	5.00%	100.000%	
2011	1,985,000	5.25%	5.20%	100.218%	Premium Bonds
2012	2,095,000 •	5.50%	5.40%	100.577%	
2013	<u>2,210,000</u>	5.50%	5.40%	100.577%	
	10,000,000				

Original Issue Discount and Original Issue Premium

Year	Principal	Price (in %)	Price (in \$)	Original Issue Premium	Original Issue Discount
2009	1,815,000	99.309%	1,802,451	-	(12,549)
2010	1,895,000	100.000%	1,895,000	-	-
2011	1,985,000	100.218%	1,989,321	4,321	-
2013	<u>4,305,000</u>	100.577%	<u>4,329,820</u>	<u>24,820</u>	<u>-</u>
	10,000,000		10,016,591	29,140	(12,549)

Bond Proceeds

Par Amount of Bonds	10,000,000
Plus:	
Original Issue Premium	16,591
Less:	
Original Issue Discount	0
Underwriters' Discount	(100,000)
Bond Insurance Premium	(50,749)
Other Costs of Issuance	<u>(100,000)</u>
Net Bond Proceeds Received by Issuer	9,765,842

Principal Amortization

Year	Principal	Interest	Debt Service	
2007		517,413	517,413	Interest Only Period
2008		517,413	517,413	
2009	1,815,000	517,413	2,332,413	Principal Amortization Period
2010	1,895,000	435,738	2,330,738	
2011	1,985,000	340,988	2,325,988	
2012	2,095,000	236,775	2,331,775	
2013	2,210,000	121,550	2,331,550	
	10,000,000	2,687,288	12,687,288	

Principal Amortization, Serial Bonds, Term Bonds, Sinking Fund, Average Life

Year	Principal	Type of Bond	Total Amount of Term Bond	Time Outstanding
2007	-	Serial		1 Year
2008	-	Serial		2 Years
2009	1,815,000	Serial		3 Years
2010	1,895,000	Serial		4 Years
2011	1,985,000	Serial		5 Years
2012	2,095,000	Term	4,305,000	6.513 Years
2013	2,210,000	Term		
	10,000,000	Average Life of Bond Issue:		5.099 Years

Section 3

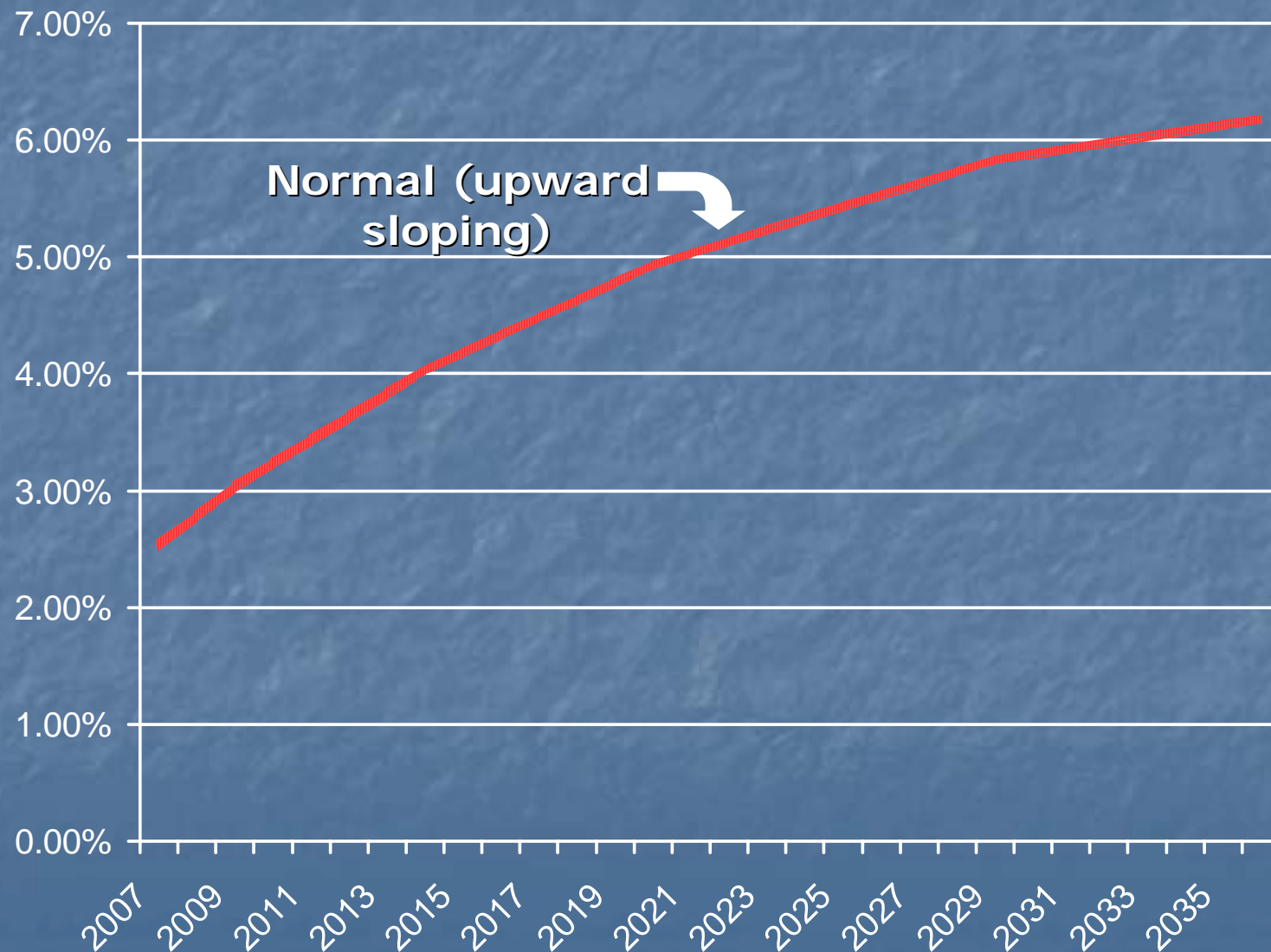
- Key Concepts – More Advanced Level



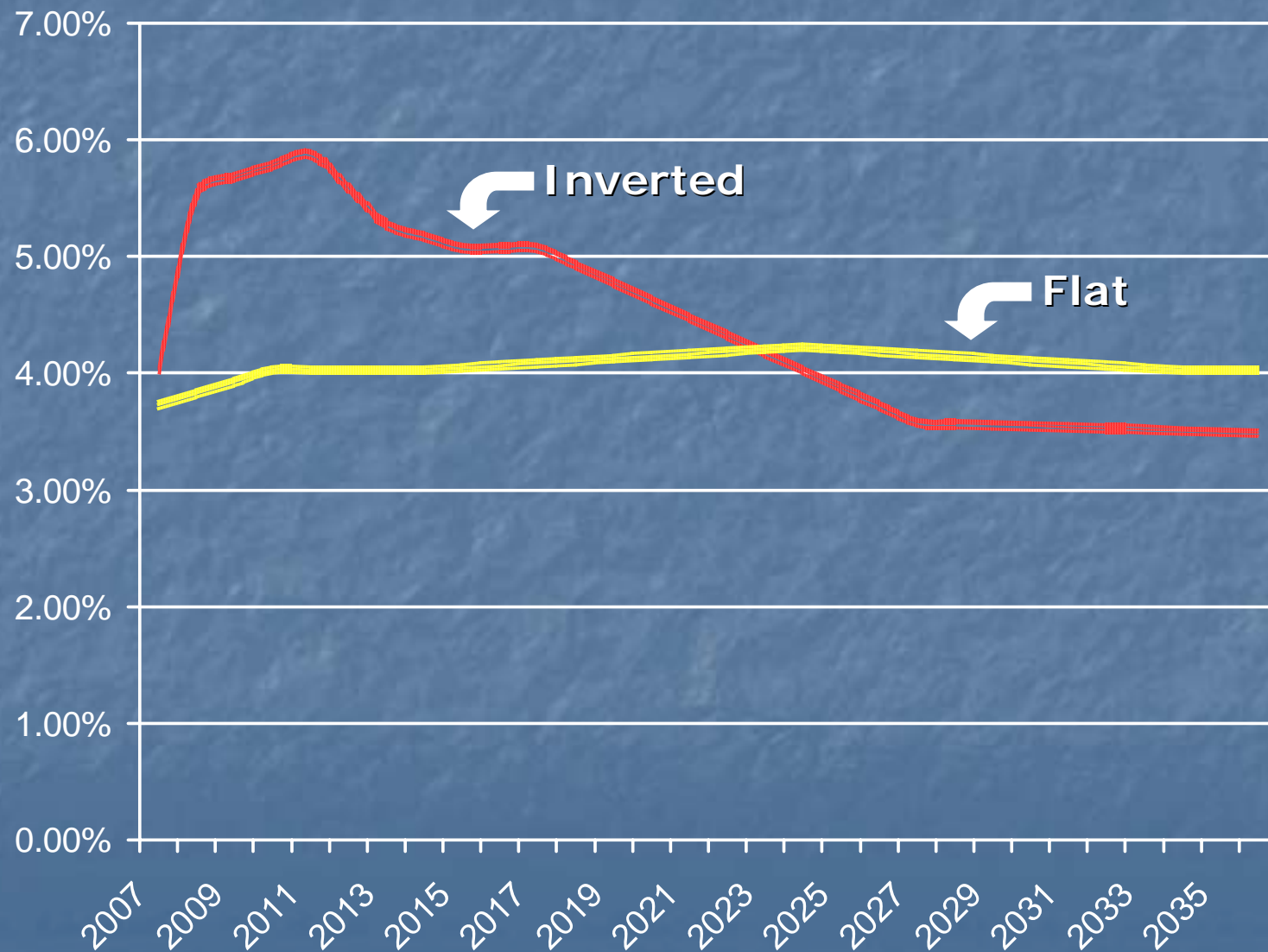
Key Concepts – More Advanced Level

- Yield Curve
- Refunding vs. New Money
- Alternate Amortization Structures
- Swaps

Yield Curve



Yield Curve



Refunding vs. New Money

New Money

Bonds issued to provide new or additional funding for a project

Refunding

Bonds issued to refinance certain existing bonds (proceeds used to repay old bonds)

Swaps

A contractual obligation in which one interest payment obligation is exchanged for a different interest payment obligation

(We won't go any further in this presentation)

Alternate Amortization Structures

Level Principal

Year	Principal	Interest	Total
2007		515,000	515,000
2008		515,000	515,000
2009	2,000,000	515,000	2,515,000
2010	2,000,000	425,000	2,425,000
2011	2,000,000	325,000	2,325,000
2012	2,000,000	220,000	2,220,000
2013	2,000,000	110,000	2,110,000
	10,000,000	2,625,000	12,625,000

Level Debt Service

Principal	Interest	Total
-	517,413	517,413
-	517,413	517,413
1,815,000	517,413	2,332,413
1,895,000	435,738	2,330,738
1,985,000	340,988	2,325,988
2,095,000	236,775	2,331,775
2,210,000	121,550	2,331,550
10,000,000	2,687,288	12,687,288

Alternate Amortization Structures

Wrap-Around Debt Service

Year	<u>Outstanding Bonds</u>				<u>New Bonds</u>				<u>Total</u>		
	Principal	Interest	Total		Principal	Interest	Total		Principal	Interest	Total
2007	800,000	185,563	985,563		1,045,000	484,825	1,529,825		1,845,000	670,388	2,515,388
2008	225,000	185,563	410,563		1,660,000	443,025	2,103,025		1,885,000	628,588	2,513,588
2009	150,000	185,563	335,563		1,805,000	372,475	2,177,475		1,955,000	558,038	2,513,038
2010	615,000	178,813	793,813		1,430,000	291,250	1,721,250		2,045,000	470,063	2,515,063
2011	725,000	148,063	873,063		1,420,000	219,750	1,639,750		2,145,000	367,813	2,512,813
2012	1,215,000	110,000	1,325,000		1,040,000	145,200	1,185,200		2,255,000	255,200	2,510,200
2013	785,000	43,175	828,175		1,600,000	88,000	1,688,000		2,385,000	131,175	2,516,175
	4,515,000	1,036,738	5,551,738		10,000,000	2,044,525	12,044,525		14,515,000	3,081,263	17,596,263

Section 4

- Key Calculations From a Bond Sale



Key Calculations From a Bond Sale

- Sources and Uses of Funds
- Debt Service Schedule
- Pricing Calculations
- Yield Calculations

Sources and Uses of Funds

Sources

Principal Amount of Bonds	10,000,000
Original Issue Premium	<u>16,591</u>
Total Sources of Funds	10,016,591

Uses

Construction Payments	8,500,000
Retire Refunded Bonds	1,265,842
Original Issue Discount	0
Insurance Premium	50,749
Costs of Issuance	<u>200,000</u>
Total Uses of Funds	10,016,591

Debt Service Schedule

Year	Principal	Interest	Debt Service
2007		517,413	517,413
2008		517,413	517,413
2009	1,815,000	517,413	2,332,413
2010	1,895,000	435,738	2,330,738
2011	1,985,000	340,988	2,325,988
2012	2,095,000	236,775	2,331,775
2013	2,210,000	121,550	2,331,550
	10,000,000	2,687,288	12,687,288

Pricing Calculations

Year	Principal	Coupon	Yield	Price
2007	-			100.000%
2008	-			100.000%
2009	1,815,000	4.50%	4.75%	99.309%
2010	1,895,000	5.00%	5.00%	100.000%
2011	1,985,000	5.25%	5.20%	100.218%
2012	2,095,000 ●	5.50%	5.40%	100.577%
2013	<u>2,210,000</u>	5.50%	5.40%	100.577%
	10,000,000			

Yield Calculations

Yield: The discount rate (applied semi-annually) at which the present value of future debt service payments are equal to the proceeds of the issue.

Yield Calculations

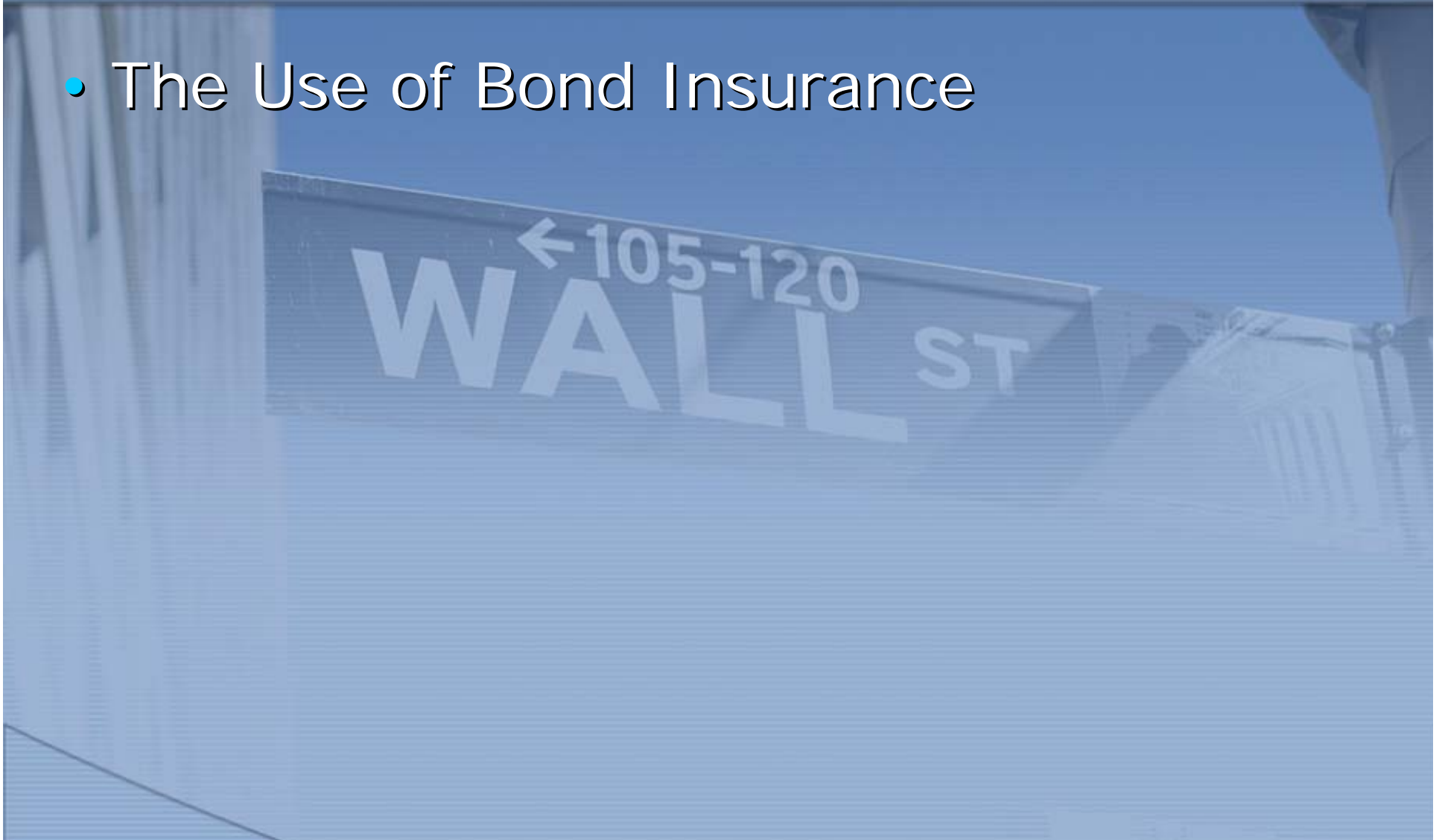
	Arbitrage Yield	True Interest Cost	All-In or True Financing Cost
Par Amount of Bonds:	10,000,000	10,000,000	10,000,000
Plus...			
Original Issue Premium:	16,591	16,591	16,591
Less...			
Original Issue Discount:	-	-	-
Insurance Premium:	(50,749)	(50,749)	(50,749)
Underwriters's Spread:		(100,000)	(100,000)
Other Costs of Issuance:			(100,000)
Target for Yield Calculations:	9,965,842	9,865,842	9,765,842

Yield Calculations

				Present Value of Debt Service at...		
				Arbitrage Yield 5.270%	True Interest Cost 5.497%	All-In or True Financing Cost 5.726%
Year	Principal	Interest	Total			
2007	-	517,413	517,413	491,187	490,104	489,010
2008	-	517,413	517,413	466,292	464,236	462,166
2009	1,815,000	517,413	2,332,413	1,995,430	1,982,250	1,969,005
2010	1,895,000	435,738	2,330,738	1,892,931	1,876,279	1,859,582
2011	1,985,000	340,988	2,325,988	1,793,326	1,773,627	1,753,921
2012	2,095,000	236,775	2,331,775	1,706,667	1,684,196	1,661,765
2013	2,210,000	121,550	2,331,550	1,620,009	1,595,151	1,570,393
	10,000,000	2,687,288	12,687,288	9,965,842	9,865,842	9,765,842
Target for Yield Calculations:				9,965,842	9,865,842	9,765,842

Section 5

- The Use of Bond Insurance



Why Use Bond Insurance?

- Higher ratings on insured bonds result in lower interest rates
- It makes sense to use insurance if:

Interest Rate Savings > Cost of Insurance

Why Use Bond Insurance?

Year	Uninsured Debt Service	Insured Debt Service	Savings	Present Value of Savings at... 5.497%
2007	537,413	517,413	20,000	18,944
2008	537,413	517,413	20,000	17,945
2009	2,342,413	2,332,413	10,000	8,499
2010	2,342,108	2,330,738	11,370	9,153
2011	2,343,568	2,325,988	17,580	13,405
2012	2,345,385	2,331,775	13,610	9,830
2013	2,340,970	2,331,550	9,420	6,445
	12,789,268	12,687,288	101,980	84,221
		Cost of Bond Insurance:		(50,749)
		Benefit/(Cost):		33,472

Calculation of Bond Insurance Premium

- One-time up front payment at time bonds are issued
- Calculated as a % of total debt service on an issue

Calculation of Bond Insurance Premium

Year	Principal	Interest	Total		
2007	-	517,413	517,413	Total Insured Debt Service:	12,687,288
2008	-	517,413	517,413	Times: Bond Insurance Premium Rate: (40 Basis Points)	0.400%
2009	1,815,000	517,413	2,332,413		
2010	1,895,000	435,738	2,330,738	Equals: Bond Insurance Premium:	50,749
2011	1,985,000	340,988	2,325,988	Impact on Yield of Insurance:	11.4 Basis Points
2012	2,095,000	236,775	2,331,775		
2013	2,210,000	121,550	2,331,550		
	10,000,000	2,687,288	12,687,288		

Overview of Bond Insurance

- Bond insurance guarantees the scheduled payment of principal and interest on a bond issue
- Provided by six major companies
 - ❖ Ambac, CIFG, FGIC, FSA, MBIA, & XL
 - ❖ All are rated "triple A" by all three rating agencies
- Insured bonds will be rated "Aaa/AAA/AAA" as a result of bond insurance

Selecting an Insurer and Using Bond Insurance

Analysis of Insurance Bids

<u>Insurer</u>	<u>Premium</u>	<u>Yield Impact</u>	<u>Trading Penalty</u>	<u>Total Cost</u>
MBIA	0.400%	0.114%	0.000%	0.114%
Ambac	0.415%	0.118%	0.000%	0.118%
FSA	0.425%	0.121%	0.000%	0.121%
FGIC	0.440%	0.125%	0.000%	0.125%
XL	0.350%	0.100%	0.040%	0.140%
CIFG	0.250%	0.071%	0.080%	0.151%

Estimated savings from insurance: 10 to 20 basis points, depending on maturity

Other Considerations About the Use of Bond Insurance

- Premium paid upfront, based on original debt service schedule; no credits for refundings or early repayment of bonds
- Payments by insurer are a “loan” or an “advance” that have to be paid back
 - ❖ Not like property or health insurance
 - ❖ A form of “credit enhancement”

Conclusion

You are all now certified as experts
in Bond Math